REMARKS

I. Introduction

In response to the Office Action dated May 4, 2005, claim 1 has been amended. Claims 1-3 and 5-8 remain in the application. Re-examination and re-consideration of the application, as amended, is requested.

II. Prior Art Rejections

A. The Office Action Rejections

On page (2) of the Office Action, claims 1 and 7 were rejected under 35 U.S.C. §102(b) as being anticipated by Suzuki et al., U.S. Patent No. 5,543,353 (Suzuki). On page (4) of the Office Action, claims 2-3 and 8 were rejected under 35 U.S.C. §103(a) as being unpatentable over Suzuki in view of Coldren, U.S. Patent No. 4,896,325 (Coldren). On page (5) of the Office Action, claim 5 was rejected under 35 U.S.C. §103(a) as being unpatentable over Suzuki in view of Berger et al., U.S. Patent No. 5,208,821 (Berger). Also on page (5), claim 6 was rejected under 35 U.S.C. §103(a) as being unpatentable over Suzuki in view of Yap, U.S. Patent No. 5,138,626 (Yap).

Applicants' attorney respectfully traverses the rejections in light of the amendments above and the arguments below.

B. Applicants' Independent Claim

Independent claim 1 is directed to a tunable laser source comprising

a widely tunable semiconductor laser comprised of an active region including multiple quantum wells (MQWs) grown on top of a thick, low bandgap, single common waveguide layer, wherein both the waveguide layer and the active region are fabricated between a p-doped region and an n-doped region; and

an electro-absorption modulator integrated into the semiconductor laser, wherein the electro-absorption modulator does not include quantum wells (QWs) and instead uses Franz-Keldysh effects for modulation and tuning, the electro-absorption modulator shares the waveguide layer with the semiconductor laser, and the waveguide layer is designed to provide high index tuning efficiency in the laser and good reverse bias extinction in the modulator.

C. The Suzuki Reference

Suzuki describes a semiconductor photonic integrated circuit and a manufacturing method thereof involving a selective-area growth technique using a set of insulating film patterning masks formed on a semiconductor substrate. The mask width and the mask-to-mask open space width are variable but numerically limited. A single crystal growth process is carried out to form on the same substrate a plurality of contiguous bulk semiconductor layers or quantum well layers differing from one another in terms of growth layer thickness or composition. The differences in energy level between these layers are utilized so that semiconductor photonic integrated devices of different functions are formed on the substrate.

D. The Coldren Reference

Coldren describes an improvement for allowing selective tuning of the emitted beam over a broad bandwidth to a diode laser having an active section for creating a light beam by spontaneous emission over a bandwidth around some center frequency and for guiding and reflecting the light beam between a pair of mirrors bounding the active on respective ends thereof to create an emitted beam of laser light. The mirrors each have narrow, spaced reflective maxima with the spacing of the reflective maxima of respective ones of the mirrors being different whereby only one the reflective maxima of each of the mirrors can be in correspondence and thereby provide a low loss window at any time. The preferred mirrors each include a plurality of discontinuities to cause the narrow, spaced reflective maxima wherein the spacing of the discontinuities of one mirror is different from the spacing of the discontinuities of the other mirror so as to cause the wavelength spacing of the maxima to be different. Additionally, the preferred embodiment includes a vernier circuit operably connected to the mirrors for providing an electrical signal to the mirrors which will cause continuous tuning within a desired frequency band, an offset control circuit operably connected to the mirrors for providing a voltage signal to the mirrors which will shift the reflective maxima of the mirrors into alignment at a desired frequency mode, and a phase control circuit for adjusting the laser mode wavelength to be in correspondence with the low loss window.

E. The Berger Reference

Berger describes an invention that pertains to buried heterostructure lasers which have been fabricated using a single step MOCVD growth of an MQW laser structure over a pattern etched GaAs substrate. The wet chemical etching of grooves having a dovetailed cross-section and being parallel to the [011] direction in GaAs substrates produced reentrant mesas which resulted in isolated laser active regions buried by the AlGaAs cladding layer. The 250 .mu.m long uncoated lasers emit at about 1 .mu.m. Lasers with coated facets have threshold currents of 20 mA and emit >100 mW per facet under room temperature operation. The external differential quantum efficiency for currents of from 30 mA to about 50 mA is found to be nearly independent of temperature in the range of 10.degree. C. to 90.degree. C. suggesting a low temperature dependence of leakage current.

F. The Yap Reference

Yap describes a laser structure that achieves high reliability, good bandwidth and performance characteristics and a fabrication procedure that is compatible with other IC devices by providing an active lasing region below an optical mode confining ridge. The active region is preferably a multiple quantum well (MQW) that is sandwiched between upper and lower cladding layers. The portions of the MQW lateral to the ridge are compositionally disordered to give them a larger bandgap energy and lower refractive index than the active MQW region, and thus resist charge carrier spreading from the MQW. The ridge provides the primary optical mode confinement, allowing a shallow burial of the MQW to a depth less than 0.5 microns. This permits the compositional disordering of the lateral MQW regions to be performed by a heated ion implantation process that requires a lower temperature than separate implantation and annealing, and is compatible with the provision of additional circuitry on the same substrate.

G. The Applicants' Invention is Patentable Over the References

Applicants' attorney respectfully submits that the claims, as amended, are patentable over the references. Specifically, Applicants' claims recite limitations not shown in the references, taken individually or in combination.

Applicants' claim 1 recites a widely tunable semiconductor laser comprised of an active region including multiple quantum wells (MQWs) grown on top of a thick, low bandgap, single

common waveguide layer without quantum wells. Applicants' claim 1 also recites an electro-absorption modulator integrated into the semiconductor laser that does not include quantum wells (QWs) and instead uses Franz-Keldysh effects for modulation and tuning.

Suzuki, on the other hand, describes a laser that is very narrowly tunable and is restricted to selective-area growth with QWs centered in the waveguide. In addition, Suzuki describes QWs in the modulator, and QW modulators will not work over a wide bandwidth efficiently. Because of the QWs in the modulator, Suzuki relies on Quantum-Confined Stark Effects (QCSE), which uses a different physical effect for modulation and tuning, as compared to the Franz-Keldysh or 'bulk' effects used in Applicants' invention. Finally, Suzuki requires a complex growth process over a patterned substrate, while Applicants' device results from a simple planar growth and therefore is more manufacturable.

Coldren, Berger and Yap fail to overcome the deficiencies of Suzuki. Recall that Coldren was cited only against dependent claims 2-3 and 8, and then only for the structure of the laser; Berger was cited only against dependent claim 5, and then only for the structure of the waveguide as a buried heterostructure that includes MQWs; and Yap was cited only against dependent claim 6, and then only for the structure of the waveguide as a ridge waveguide that includes MQWs.

In addition, Berger also requires a complex growth process over a patterned substrate, while Applicants' device results from a simple planar growth and therefore is more manufacturable. Berger's QCSE (QW) modulators are desirable in fixed or narrowly-tunable sources, and are not useful for widely-tunable sources, because the effect is limited to a more narrow wavelength region.

Further, Yap shows the use of compositioned disordering to change the bandgap lateral to a ridge waveguide. This does not suggest an offset QW gain region. Instead, Yap is focused on centered QWs within the waveguide that must be modified to change the bandgap.

Thus, the references, taken individually or in combination, do not teach or suggest Applicants' claimed invention. Moreover, the various elements of Applicants' claimed invention together provide operational advantages over the references. In addition, Applicants' claimed invention solves problems not recognized by the references.

Consequently, Applicants' attorney submits that independent claim 1 is allowable over the references. Further, dependent claims 2-8 are submitted to be allowable over the references

in the same manner, because they are dependent on independent claim 1, and thus contain all the limitations of the independent claim. In addition, dependent claims 2-8 recite additional novel elements not shown by the references.

III. Conclusion

In view of the above, it is submitted that this application is now in good order for allowance and such allowance is respectfully solicited. Should the Examiner believe minor matters still remain that can be resolved in a telephone interview, the Examiner is urged to call Applicants' undersigned attorney.

Respectfully submitted,

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